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(54) **METHOD AND APPARATUS FOR BYPASSING A PAYLOAD NODE**

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H04L 12/26 (2006.01)

(52) **U.S. Cl.** **370/217**; 370/221; 370/225; 370/351

(58) **Field of Classification Search** 370/216, 370/217, 221, 225, 227, 228, 401–404, 347, 370/351, 541, 536–528
See application file for complete search history.

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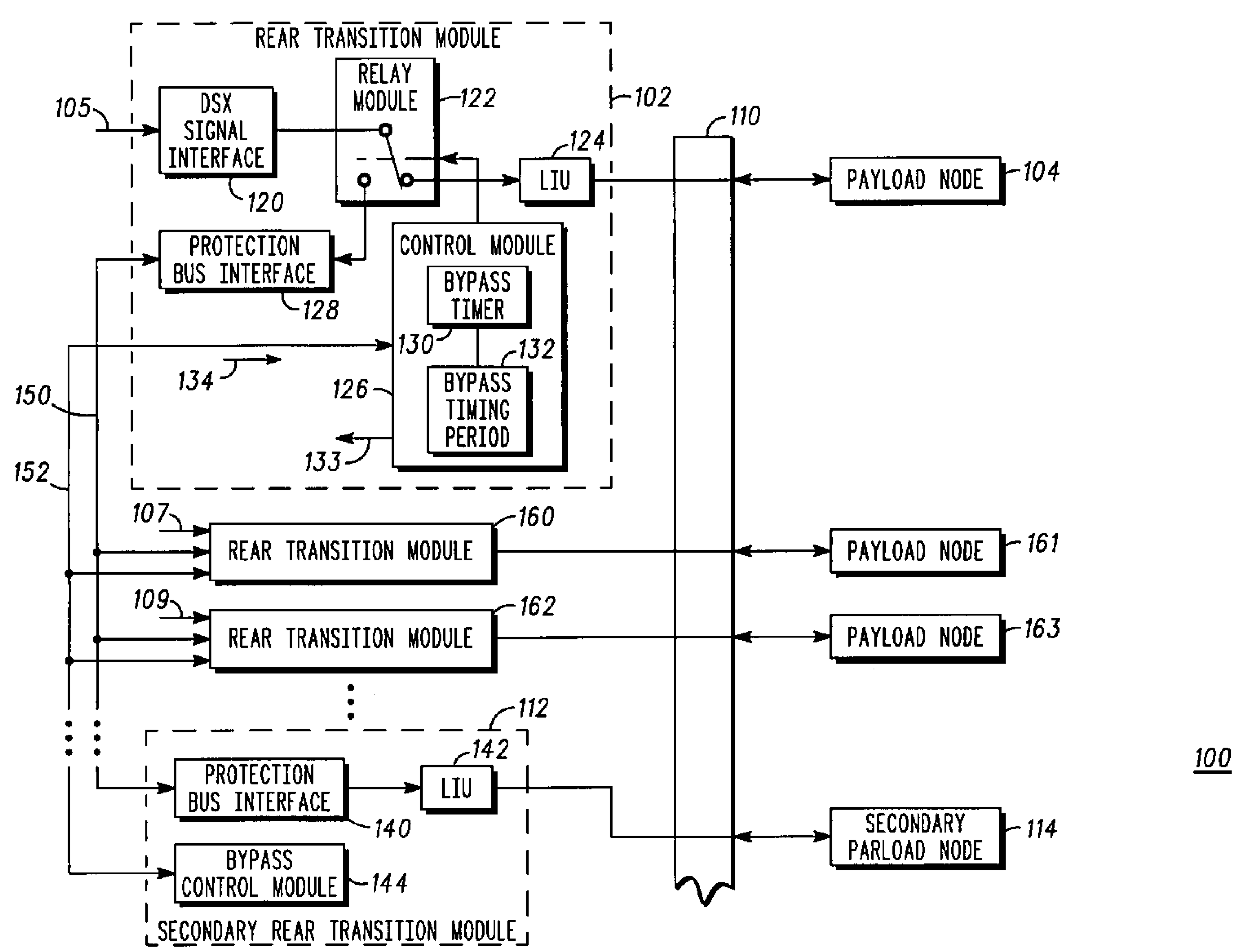
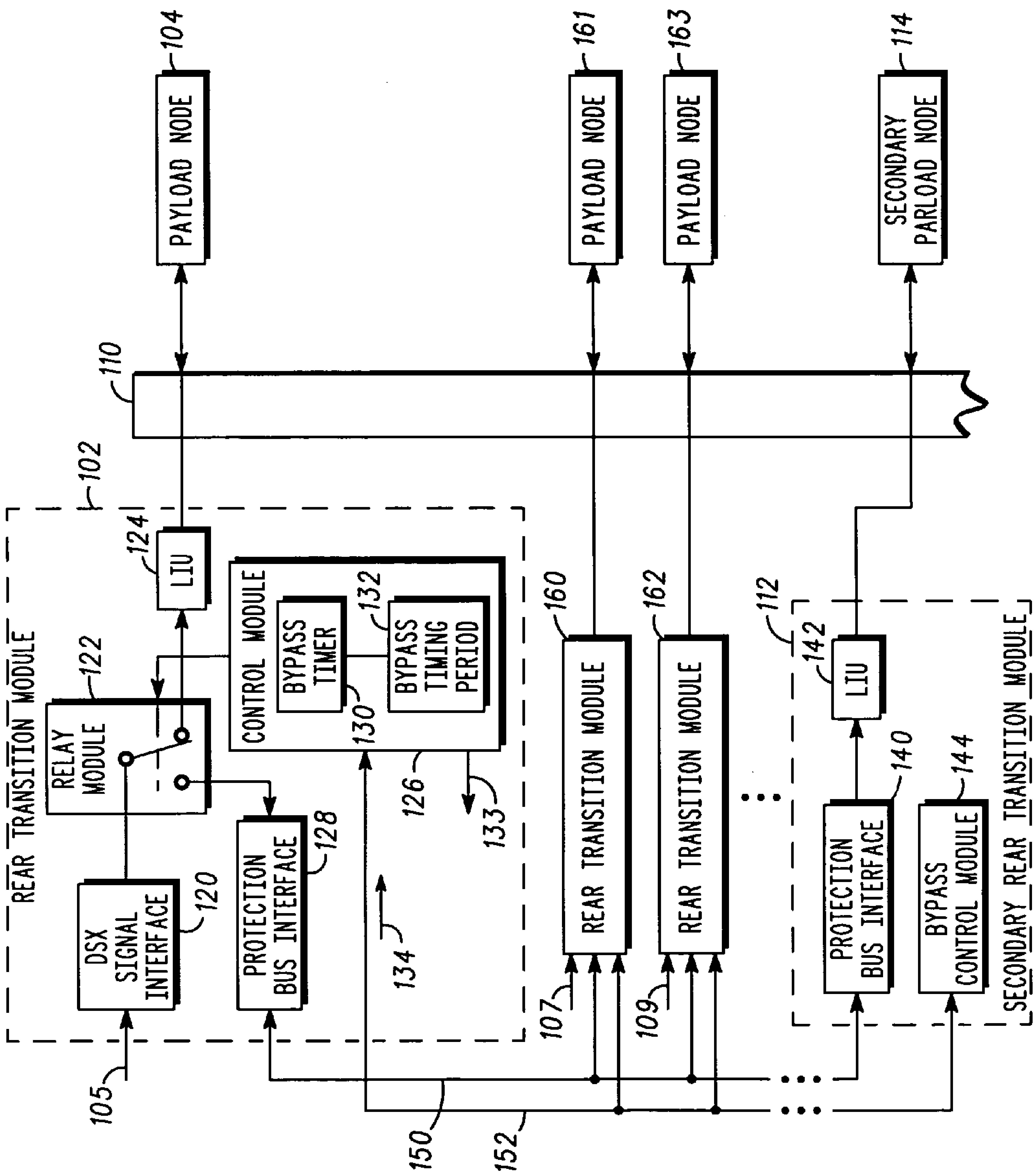
(57) **ABSTRACT**

A multi-service platform system **(100)** includes a rear transition module **(102)** coupled to receive a DSX signal **(105)** and a payload node **(104)** coupled to the rear transition module via a backplane **(110)**, where the payload node is coupled to process the DSX signal. A secondary payload node **(114)** is coupled to secondary rear transition module **(112)** via the backplane. A protection bus **(150)** couples the rear transition module to the secondary rear transition module outside the backplane, where failure of the payload node operates to shunt the DSX signal through the rear transition module to the secondary rear transition module. Failure of the payload node operates to switch processing of the DSX signal from the payload node to the secondary payload node, and the secondary rear transition module independently controls shunting of the DSX signal through the rear transition module to the secondary rear transition module.

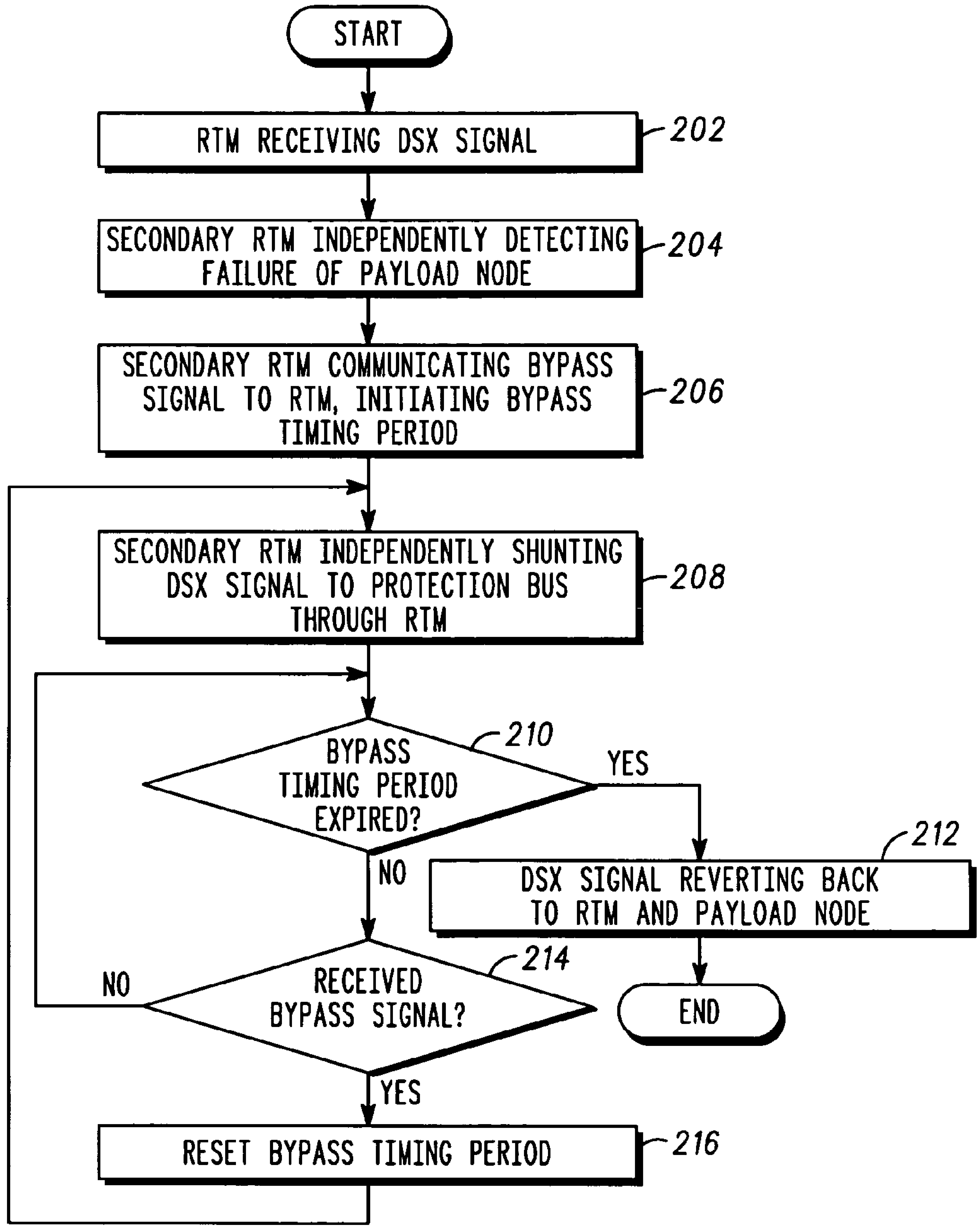
7 Claims, 2 Drawing Sheets




PAYLOAD NODE
104
PAYLOAD NODE
161
PAYLOAD NODE
163
SECONDARY PARLOAD NODE
114
110
102
REAR TRANSITION MODULE
DSX SIGNAL INTERFACE
120
RELAY MODULE
122
LIU
124
CONTROL MODULE
BYPASS TIMER
130
BYPASS TIMING PERIOD
132
126
133
PROTECTION BUS INTERFACE
128
134
105
REAR TRANSITION MODULE
160
107
REAR TRANSITION MODULE
162
109
112
LIU
142
PROTECTION BUS INTERFACE
140
BYPASS CONTROL MODULE
144
SECONDARY REAR TRANSITION MODULE
150
152

100

FIG. 1


START
RTM RECEIVING DSX SIGNAL
202
SECONDARY RTM INDEPENDENTLY DETECTING FAILURE OF PAYLOAD NODE
204
SECONDARY RTM COMMUNICATING BYPASS SIGNAL TO RTM, INITIATING BYPASS TIMING PERIOD
206
SECONDARY RTM INDEPENDENTLY SHUNTING DSX SIGNAL TO PROTECTION BUS THROUGH RTM
208
BYPASS TIMING PERIOD EXPIRED?
210
YES
NO
DSX SIGNAL REVERTING BACK TO RTM AND PAYLOAD NODE
212
RECEIVED BYPASS SIGNAL?
214
NO
END
YES
RESET BYPASS TIMING PERIOD
216

200

FIG. 2

METHOD AND APPARATUS FOR BYPASSING A PAYLOAD NODE

BACKGROUND OF THE INVENTION

Prior art methods of receiving time division multiplexed (TDM) signals into a chassis-type network include channeling DSX signals to each individual payload node or using a dedicated path (as provided in H.110) to distribute DSX signals to payload nodes within a chassis. In such a system, it is desirable to have in place a reliable failover mechanism if a payload node fails. Prior art methods of accomplishing this include proprietary means using specialized buses incorporated into the backplane of the computer system chassis. The prior art required modification of the standard backplane system to accommodate a failover mechanism. Other prior art methods require equipment external to the chassis to provide a failover mechanism. These prior art methodologies have the disadvantage of requiring additional complexity, cost and operator attention. It is desirable to provide a failover mechanism using an N+1 configuration and one that fits within existing chassis without modification of the backplane.

Accordingly, there is a significant need for an apparatus and method that overcomes the disadvantages of the prior art outlined above.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the drawing:

FIG. **1** depicts a block diagram of a multi-service platform system according to one embodiment of the invention; and

FIG. **2** illustrates a flow diagram according to an embodiment of the invention.

It will be appreciated that for simplicity and clarity of illustration, elements shown in the drawing have not necessarily been drawn to scale. For example, the dimensions of some of the elements are exaggerated relative to each other. Further, where considered appropriate, reference numerals have been repeated among the Figures to indicate corresponding elements.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following detailed description of exemplary embodiments of the invention, reference is made to the accompanying drawings, which illustrate specific exemplary embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, but other embodiments may be utilized and logical, mechanical, electrical and other changes may be made without departing from the scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the appended claims.

In the following description, numerous specific details are set forth to provide a thorough understanding of the invention. However, it is understood that the invention may be practiced without these specific details. In other instances, well-known circuits, structures, software blocks and techniques have not been shown in detail in order not to obscure the invention.

For clarity of explanation, the embodiments of the present invention are presented, in part, as comprising individual functional blocks. The functions represented by these blocks

may be provided through the use of either shared or dedicated hardware, including, but not limited to, hardware capable of executing software. The present invention is not limited to implementation by any particular set of elements, and the description herein is merely representational of one embodiment.

FIG. **1** depicts a block diagram of a multi-service platform system **100** according to one embodiment of the invention. Multi-service platform system **100** can include a multi-service platform system chassis, with software and any number of slots for inserting nodes, for example, rear transition module **102**, **160**, **162**, payload node **104**, **161**, **163**, secondary rear transition module **112** and secondary payload node **114**. In an embodiment, a backplane **110** can be used for connecting nodes placed in slots. Backplane **110** can be a packet switched backplane or a multi-drop parallel bus backplane, or both as is known in the art. As an example of an embodiment, a multi-service platform system **100** can include chassis having model MCIP805 manufactured by Motorola Computer Group, 2900 South Diablo Way, Tempe, Ariz. 85282. The invention is not limited to this model or manufacturer and any multi-service platform system is included within the scope of the invention.

As shown in FIG. **1**, multi-service platform system **100** can comprise any number of rear transition modules **102**, **160**, **162**, payload nodes **104**, **161**, **163**, a secondary rear transition module **112** and a secondary payload node **114** coupled via backplane **110**. In an embodiment, rear transition module **102**, **160**, **162** can be inserted into slots of multi-service platform system **100** to provide an interface for non-packetized signals received by multi-service platform system **100**. For example, rear transition modules **102**, **160**, **162** can receive time division multiplex (TDM) based signals, which can be DSX signals **105**, **107**, **109** respectively.

Payload nodes **104**, **161**, **163** can add functionality to multi-service platform system **100** through the addition of processors, memory, storage devices, I/O elements, and the like. In other words, payload nodes **104**, **161**, **163** can include any combination of processors, memory, storage devices, I/O elements, and the like, to give multi-service platform system **100** the functionality desired by a user. In an embodiment, a chassis can include slots for up to 18 payload nodes. In an embodiment, there can be 17 payload slots for 17 payload nodes in multi-service platform system **100** and one slot for secondary payload node **114**, which acts as a standby. However, any number of payload slots and payload nodes are included in the scope of the invention.

In an embodiment, multi-service platform system **100** can include one or more switch nodes (not shown for clarity) as a central switching hub with any number of payload nodes as is known in the art. Switch node can further distribute packetized traffic to other Internet Protocol (IP) based networks.

Multi-service platform system **100** can be based on a point-to-point, switched input/output (I/O) fabric, a parallel multi-drop bus type network, and the like. Multi-service platform system **100** can include both node-to-node (for example computer systems that support I/O node add-in slots) and chassis-to-chassis environments (for example interconnecting computers, external storage systems, external Local Area Network (LAN) and Wide Area Network (WAN) access devices in a data-center environment). Although the embodiment depicted in FIG. **1** illustrates a single chassis, the method and apparatus can be practiced between multiple chassis and be within the scope of the invention.

In an embodiment, rear transition module **102** can receive any number of DSX signals **105** at DSX signal interface **120**. DSX signal **105** represents one of a series of standard digital transmission rates based on DS0, a transmission rate of 64 kilobites per second (Kbps), the bandwidth normally used for one telephone voice channel. DS1, used as the signal in a T-1 carrier, carries a multiple of 24 DS0 signals or 1.544 Megabits per second (Mbps). DS3, the signal in a T-3 carrier, carries a multiple of 28 DS1 signals or 672 DS0 signals or 44.74 Mbps. Although DSX signal **105** is shown as only one path, it is understood that in an embodiment, DSX signal **105** can have both transmit and receive paths. DSX signal **105** is shown as a single path for clarity.

Rear transition module **102** can include DSX signal interface **120**, which can be the physical connection allowing rear transition module **102** to receive DSX signal **105**. For example, DSX signal interface **120** can include a BNC or TNC type connector for DSX signals as is known in the art. In another embodiment, DSX signal interface **120** can be an optical connection, such as OC3 optical fibers, or higher capacity fibers, and the like. DSX signal **105** can include TDM payload data, which can be time division multiplexed data, such as telephone voice data, and the like.

In an embodiment, DSX signal **105** can pass through relay module **122** to a line interface unit (LIU) **124**, which can provide an interface for DSX signal to enter backplane **110**. In an embodiment, LIU **124** can take the DSX signal **105** and convert it to 8 bit DS0 samples for further processing prior to entering backplane **110** and payload node **104**.

In an embodiment, DSX signal or components thereof can be sent along backplane **110** to payload node **104** for further use or processing. In another embodiment, DSX signal or components thereof can be distributed to more than one payload node via backplane **110**. In an embodiment, DSX signal can contain TDM payload data that can be communicated to payload node **104** for use or processing.

In an embodiment, line interface unit **124** can include a controller, which can be an intelligent platform management interface (IPMI) as is known in the art. In an embodiment, LIU **124** is coupled to provide an electrical interface with backplane **110**. In an embodiment, electrical interface can be low voltage differential signaling (LVDS). In an example of an embodiment, electrical interface can be a standard 100BaseT Ethernet physical connection, and the like.

In the embodiment shown in FIG. **1**, multi-service platform system **100** is shown in an N+1 configuration, which includes N payload nodes with corresponding rear transition modules and one secondary payload node and its corresponding secondary rear transition module. Secondary payload node **114** and secondary rear transition module **112** can be used as a spare in the event one of payload nodes has a failure. For example, in accordance with an embodiment of the invention, failure of payload node **104** causes DSX signal **105** to be automatically shunted to secondary payload node **114** for processing using the apparatus and method described below. Failure of payload node **104** can include, but is not limited to, electrical, mechanical, logical or other malfunction that prevents payload node **104** from accomplishing its intended task. For example, a power failure on payload node **104** is a failure of payload node **102**. In another embodiment, multi-service platform system **100** can be configured for a 1+1 configuration where each payload node has a corresponding spare in the chassis or system. In this configuration, the failure of a payload node causes the corresponding DSX signal to be automatically switched over to the corresponding spare payload node using the apparatus and method described below.

In an embodiment, rear transition module **102** is coupled to secondary rear transition module **12** via protection bus **150** outside of backplane **110**. In other words, protection bus **150** is not part of the chassis or backplane. Protection bus **150** is an independent bus coupling rear transition module **102** and secondary rear transition module **112** that does not interface or use backplane **110**. Therefore, protection bus **150** can be used in existing multi-service platform system chassis and in new multi-service platform system chassis without modification or addition of components. Although protection bus **150** is shown as only one path, it is understood that in an embodiment, protection bus **150** can have both transmit and receive paths. Protection bus **150** is shown as a single path for clarity. In an embodiment, protection bus **150** can be connected to all of the rear transition modules in multi-service platform system **100** regardless of whether the rear transition modules are in a single or multiple chassis. In effect, protection bus "daisy chains" together each of the rear transition modules and secondary rear transition module **112**.

In an embodiment, rear transition module **102** can include protection bus interface **128**. For example, protection bus interface **128** can include a BNC or TNC type connector for DSX signals similar to that described for DSX signal interface **120**. In another embodiment, protection bus interface **128** can be an optical connection, such as OC3 optical fibers, or higher capacity fibers, and the like. Secondary rear transition module **112** can include protection bus interface **140**, which is substantially similar to protection bus interface **128**. Protection bus **150** is coupled to rear transition module **102** via protection bus interface **128**, while secondary rear transition module **112** is coupled to protection bus **150** via protection bus interface **140**. Each rear transition module **160**, **162** can also have a protection bus interface (not shown for clarity) which couples it to protection bus **150**.

Rear transition module **102** can also include relay module **122**. Relay module **122** can couple DSX signal interface **120** to LIU **124** allowing DSX signal **105** to reach payload node **104**. In an embodiment, this is the default position of relay module **122**. Relay module can also be configured such that DSX signal **105** is communicated to protection bus **150** via protection bus interface **128**. This is described in more detail below. Relay module **122**, can be for example and without limitation, an analog relay module as is known in the art.

Secondary rear transition module **112** can include bypass control module **144**. In an embodiment, bypass control module **144** can detect failure of payload node **104** via backplane **110**. Upon detection of failure of payload node **104**, bypass control module **144** can communicate bypass signal **134** to rear transition module **102**, particularly to control module **126**. Control module **126** can then switch relay module **122** such that DSX signal **105** is shunted through rear transition module **102** to secondary rear transition module **112** via protection bus **150**. Secondary rear transition module **112** independently controls both control module **126** and relay module **122**. Secondary rear transition module **112** operates independently to detect payload node **104** failures and shunt DSX signal **105** without any reliance on circuitry or signals from payload node **104**. In effect secondary rear transition module **112** does not rely on any circuitry that may be the source of the payload node failure.

In an embodiment, rear transition module **102** can also comprise control module **126**, which can comprise a serial register, coupled to receive a bypass signal **134** from secondary rear transition module **112** to activate relay module **122**. Control module **126** can be coupled to secondary rear transition module **112** via a control bus **152**. In an embodiment, control bus **152** can be part of protection bus **150**. In another embodiment, control bus **152** can be separate from protection bus **150**. In either embodiment, control bus **152** is also outside of and separate from backplane **110**. Control bus **152** can be coupled to the control module of other rear transition modules **160**, **162** as well. Since control module **126** is independently controlled by secondary rear transition module **112**, control module **126** is also independently powered by secondary rear transition module **112** to protect against failure of payload node **104** and power to rear transition module **102**. Control module of other rear transition modules **160**, **162** is also independently controlled and powered by secondary rear transition module **112**.

Control module **126** can also comprise bypass timer **130** coupled to define bypass timing period **132**. Bypass timer **130** can begin bypass timing period **132**, for example, upon receipt of bypass signal **134** from secondary rear transition module **112**. Bypass timing period **132** can be a definite but arbitrary value set by a system architect or a user of multi-service platform system **100**. In an embodiment, upon failure of payload node **104**, secondary rear transition module **112** periodically communicates bypass signal **134** to rear transition module **102**, particularly to control module **126**. The initial communication of bypass signal **134** initiates bypass timing period **132**.

Thereafter, in order to maintain the shunting of DSX signal **105** to secondary rear transition module **112**, the secondary rear transition module **112** must periodically communicate bypass signal **134** to rear transition module **102** prior to expiration of bypass timing period **132**. If bypass signal **134** is not received by rear transition module **102** prior to expiration of bypass timing period **132**, DSX signal **105** reverts back passing through rear transition module **102** to payload node **104**. In other words, control module **126** will release relay module **122** such that DSX signal **105** passes through rear transition module **102** to payload node **104**. This feature ensures that failure of secondary rear transition module **112** or secondary payload node **114** permits rear transition module **102** to resume control over DSX signal **105**.

Upon DSX signal **105** being shunted to secondary rear transition module **112**, DSX signal **105** is further communicated via LIU **142** to secondary payload node **114** for processing. DSX signal **105** is shunted to secondary payload node **114** for processing in the event payload node **104** fails. Since shunting of DSX signal **105** is independently controlled by secondary rear transition module **112**, the failure of payload node **104** does not affect the ability of secondary rear transition module **112** to operate relay module **122** to shunt DSX signal **105**. Relay module **122** defaults or fails to such that DSX signal **105** is communicated to payload node **104**. If secondary rear transition module **112** or secondary payload node **114** fail, it has no effect on rear transition module **102**, payload node **104** or DSX signal **105** being processed by payload node **104**.

Control module **126** can also issue a status signal **133** upon receipt of bypass signal **134**. Status signal **133** can communicate to payload node **104** that DSX signal **105** is shunted to secondary rear transition module **112**. In an embodiment, if payload node **104** receives status signal **133** indicating DSX signal **105** is shunted, but payload node **104** has not failed, payload node **104** can then reacquire DSX signal **105** or silence secondary rear transition module **112** or secondary payload node **114**.

In an embodiment, protection bus **150** is coupled to other rear transition modules **160**, **162** in multi-service platform system **100**. In this embodiment, failure of payload node **161** or payload node **163** operates to shunt DSX signal **107** or DSX signal **109** respectively to secondary rear transition module **112** in the manner described above.

In an embodiment, each rear transition module **102** contains its own unique address as recognized by protection bus **150**. When a payload node fails and a DSX signal is shunted, the address of the corresponding rear transition module is placed on the protection bus **150** so that other rear transition modules know that protection bus **150** is already in use. Other control modules are then aware that protection bus and secondary rear transition module **112** are in use. This is to prevent other rear transition modules from attempting to use protection bus to shunt DSX signal while protection bus is in use. In this manner, protection bus, secondary rear transition module **112** and secondary payload node **114** only operate as a spare for a failure of one payload node within multi-service platform system **100**.

FIG. **2** illustrates a flow diagram **200** according to an embodiment of the invention. In step **202**, rear transition module (RTM) **102** is receiving DSX signal **105**. In step **204**, secondary rear transition module **112** independently detects failure of payload node **104**. In step **206**, secondary rear transition module **112** communicates bypass signal **134** to rear transition module **102**, initiating bypass timing period **132**.

In step **208**, secondary rear transition module **112** independently shunts DSX signal **105** to protection bus **150** through rear transition module **102** such that DSX signal **105** is communicated to secondary rear transition module **112** for processing by secondary payload node **114**, where protection bus **150** is outside of backplane **110**. Secondary rear transition module **112** independently controls shunting of DSX signal **105** through rear transition module **102** to secondary rear transition module **112**.

In step **210** it is determined if bypass timing period **132** has expired. If bypass timing period **132** has expired, DSX signal **105** reverts back to passing through rear transition module **102** to payload node per step **212**. If bypass timing period **132** has not expired, it is determined in step **214** if bypass signal **134** has been received from secondary rear transition module **112** during bypass timing period **132**. If not, it is again checked if bypass timing period **132** has expired per step **210**. If bypass signal **134** is received prior to expiration of bypass timing period **132**, bypass timing period **132** is reset per step **216** and shunting of DSX signal **105** continues per step **208**.

While we have shown and described specific embodiments of the present invention, further modifications and improvements will occur to those skilled in the art. It is therefore to be understood that appended claims are intended to cover all such modifications and changes as fall within the true spirit and scope of the invention.

What is claimed is:

1. A multi-service platform system, comprising:

a rear transition module coupled to receive a DSX signal, wherein the rear transition module further comprises a bypass timer coupled to define a bypass timing period;

a payload node coupled to the rear transition module via a backplane, wherein the payload node is coupled to process the DSX signal;

a secondary rear transition module;

a secondary payload node coupled to the secondary rear transition module via the backplane; and

a protection bus coupling the rear transition module to the secondary rear transition module outside the backplane, wherein failure of the payload node operates to shunt the DSX signal through the rear transition module to the secondary rear transition module, wherein failure of the payload node operates to switch processing of the DSX signal from the payload node to the secondary payload node, and wherein the secondary rear transition module independently controls shunting of the DSX signal through the rear transition module to the secondary rear transition module, wherein upon failure of the payload node, the secondary rear transition module periodically communicates a bypass signal to the rear transition module initiating the bypass timing period, and wherein if the rear transition module fails to receive the bypass signal prior to expiration of the bypass timing period, the DSX signal reverts back to passing through the rear transition module to the payload node.

2. The multi-service platform system of claim **1**, wherein upon receipt of the bypass timing signal, the bypass timing period is reset.

3. A rear transition module coupled to transmit a DSX signal to a payload node via a backplane, the rear transition module comprising:

a DSX signal interface coupled to receive the DSX signal;

a protection bus interface, wherein the protection bus interface is coupled to a secondary rear transition module via a protection bus, wherein the protection bus is outside the backplane;

a relay module coupled to switch the DSX signal from the payload node to the secondary rear transition module for processing by a secondary payload node; and

a control module, wherein the control module operates to switch the relay module such that the DSX interface is coupled to the protection bus interface upon failure of the payload node and receipt of a bypass signal from the secondary rear transition module, and wherein the control module is independently controlled by the secondary rear transition module, wherein the control module further comprises a bypass timer coupled to define a bypass timing period, wherein upon failure of the payload node, the secondary rear transition module communicates the bypass signal to the control module initiating the bypass timing period, and wherein if the control module fails to receive the bypass signal prior to expiration of the bypass timing period, the DSX signal reverts back to the rear transition module from the secondary rear transition module.

4. The rear transition module of claim **3**, wherein upon receipt of the bypass timing signal, the bypass timing period is reset.

5. A method, comprising:

a rear transition module receiving a DSX signal, wherein the rear transition module passes the DSX signal to a payload node through a backplane;

a secondary rear transition module independently detecting failure of the payload node;

the secondary rear transition module independently shunting the DSX signal to a protection bus through the rear transition module such that the DSX signal is communicated to the secondary rear transition module for processing by a secondary payload node, wherein the protection bus is outside the backplane, and wherein the secondary rear transition module independently controls shunting of the DSX signal through the rear transition module to the secondary rear transition module;

the secondary rear transition module periodically communicating a bypass signal to the rear transition module;

receipt of the bypass signal initiating a bypass timing period; and

if the rear transition module fails to receive the bypass signal prior to expiration of the bypass timing period, the DSX signal reverting back to passing through the rear transition module to the payload node.

6. The method of claim **5**, further comprising upon receipt of the bypass signal resetting the bypass timing period.

7. A secondary rear transition module, comprising:

a protection bus interface, wherein the protection bus interface is coupled to a rear transition module via a protection bus, wherein the protection bus is outside of a backplane; and

a bypass control module, wherein the bypass control module operates to switch a relay module on the rear transition module such that a DSX signal received at the rear transition module is shunted through the rear transition module to the secondary rear transition module upon failure of a payload node coupled to the rear transition module, and wherein the secondary rear transition module independently detects the failure of the payload node and independently controls the shunting of the DSX signal, wherein the secondary rear transition module periodically communicates a bypass signal to the rear transition module initiating a bypass timing period, and wherein if the rear transition module fails to receive the bypass signal prior to expiration of the bypass timing period, the DSX signal reverts back to passing through the rear transition module to the payload node.

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